PHYSICO-CHEMICAL PROPERTIES OF ACID SOILS OF THE TROPICS IN RELATION TO RICE GROWTH

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ABSTRACT

Results of studies on physico-chemical properties of acid soils of the tropics as related to rice growth, conducted mainly in China during the last thirty years, are reviewed. Most of acid tropical soils have a low cation-retaining capacity and a low cation-retaining intensity. Cultivation for rice leads to increases in these indexes temporarily due to the rise in soil pH as a result of reduction, and long-standingly due to the increase in organic matter content. The most important chemical consequences of the lowering of redox potential are productions of ferrous iron and sulfide. Ferrous iron can be distinguished as a water-soluble, exchangeable, complexed with the solid phase, and precipitated. The distribution among these forms is governed chiefly by the pH of the medium. Water soluble ferrous iron can be further distinguished as ionic and chelated, and the latter may be negatively charged or positively charged. High concentrations of water-soluble ferrous iron lead to the retardation of growth or even the death of rice plants. Ferrous iron may also displaced nutrient cations from the exchange sites, hastening their leaching loss.

Once formed, sulfide exist in forms of insoluble sulfides, hydrogen sulfide and sulfide ions. The chemical equilibrium between hydrogen sulfide and sulfide ions is governed by the pH of the medium. In some strongly reduced soils, the concentration of molecular hydrogen sulfide may exceed the tolerance limit of rice plants, if the pH is sufficiently low. The manifestation of the combined effect of ferrous iron and hydrogen sulfide on rice is the formation of black roots.

Moderate reduction of acid soils is favourable to the availability of phosphorus directly through the release of phosphates associated with iron oxides, and indirectly through the decrease in phosphate adsorption by soil as a result of the rice in pH.

In addition to the effects mentioned above, the change in pH caused by alternate reduction and oxidation exerts a series of effects on other properties of the acid soil.